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## ECONOMICS OF ASSISTED REPRODUCTION

# Economics of assisted reproduction: Access to fertility treatments and valuing live births in economic terms

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### Abstract

The intricate relationship between economic conditions and natural fertility is known to influence both the timing and number of children conceived. For infertile couples, the relationship between economics and fertility is more explicit because of the necessity for many couples to pay for treatment to achieve childbirth. Consequently, affordability often dictates whether or not someone is able to undergo treatment, as well as the types of treatments available. Economics can also be used to describe treatment outcomes achieved through the use of fertility treatments. While gynaecologists and couples speak of outcomes in terms of live births, economists are often inclined to view live births and their influence on society in economic terms. In this review we consider two distinct elements of economics and assisted reproduction. Firstly, how economics (i.e. affordability) can influence demand for, and access to, fertility treatments, and secondly, how methods for valuing live births achieved using assisted reproductive technologies in economic terms can highlight the importance of these children in the context of ageing populations. This review will attempt to illustrate that the economic benefits attributed to children conceived through fertility treatments are much greater than health costs required for conception and should be considered in future reimbursement decisions in this therapy area.

**Keywords:** *Economic evaluation, health investment, in vitro fertilisation, costs, infertility, total fertility rate, fertility, patient demand*

### Demand and affordability of ART

Over the past decade, the demand for assisted reproductive technologies (ARTs) has increased steadily with observable influences on national birth rates (Andersen et al., 2008; Sobotka et al., 2008). This increasing use of ARTs likely reflects many factors including rising prevalence of infertility, brought about by delays in time to first pregnancy, increasing obesity and sexually transmitted disease as well as increasing awareness and acceptance of reproductive technology (Adashi et al., 2000; Kovacs et al., 2003; Jensen et al., 2008). Prevalence estimates from population-based surveys involving more than 50,000 participants suggest that current infertility during the preceding 12 months ranges between 3.5 and 16.7% with a median of 9% (Boivin et al., 2007). Despite high prevalence, the proportion of infertile couples seeking advice and ultimately pursuing treatment is likely to be <50% (Boivin

et al., 2007). The difference between prevalence figures and utilisation reflects cultural, economic, religious, physical and psychological barriers to treatment.

Demand for, and consumption of, fertility treatments likely requires that couples understand success probabilities and associated risks such as multiple pregnancy and ovarian hyperstimulation syndrome. In markets where consumers pay for treatments, successes and risks need to be balanced with personal finances. Unfortunately, the extent to which in-vitro fertilisation (IVF) couples are able to make rational choices regarding multiple pregnancy risks and associated costs does not always appear balanced (Murray et al., 2004). In contrast, in markets where the majority of costs are reimbursed, the affordability is removed from the decision-making process and couples can focus on outcomes. This explains why more cycles are performed in countries with reimbursement (Sunde, 2007).

Despite increasing demand for fertility treatments and public support for public subsidy, healthcare authorities often provide limited or no funding for ART treatments (Adashi *et al.*, 2000). Justification for limiting reimbursement by funding authorities derives from the opinion that infertility is a lifestyle rather than a medical disorder, and consequently considered a low priority (Redmayne & Klein, 1993). Differing views of fund holders regarding the prioritisation of infertility has resulted in sporadic insurance coverage internationally with roughly 50% of countries having no reimbursement through national health services or private insurers (Jones *et al.*, 2007).

The relatively high cost for ART procedures means that reimbursement of services is an important element in ensuring delivery of care (Collins, 2002). Previous investigations have described the relationship between ART reimbursement and annual per capita treatment cycles (Jain *et al.*, 2002; Katz *et al.*, 2002; Hammoud *et al.*, 2009). Furthermore, an international comparison of treatment costs in six countries has shown that lower costs paid by consumers are associated with increased rates of ART utilisation (Chambers *et al.*, 2009). The price-elasticity of demand associated with introducing a co-payment for IVF and intracytoplasmic sperm injection (ICSI) in Germany suggests that a 10% increase in price likely reduces utilisation by 4.1% and 3.4% for IVF and ICSI, respectively (Connolly *et al.*, 2009a). Unfortunately, studies have consistently established that when treatment access is dependent on user fees that these costs can be preventative for many couples. Consequently couples with limited resources for treatment either go without care or seek treatment abroad where user fees are lower than in their home country (Pennings *et al.*, 2008).

The few studies available on costs of treatment and access to care suggest that affordability is a powerful determinant of whether couples will pursue treatment; although non-financial barriers also do exist (Hoorens *et al.*, 2008). National survey data from the United States (US) have shown that insurance coverage and finances largely dictate whether women will seek medical help to try and get pregnant (Staniec & Webb, 2007). The availability and use of IVF is also higher in US states with mandated insurance coverage therefore minimising the financial barriers to care (Hammoud *et al.*, 2009). A study in Germany has shown that reductions in ART use following the introduction of patient co-payments was greatest in federal states with the lowest annual gross domestic product (Griesinger *et al.*, 2007).

Affordability and cost constraints can also influence clinical practice and treatment choices made by consumers. Data from the US have shown that

insurance coverage can influence the number of embryos transferred and consequently multiple birth rates leading to increased healthcare costs (Reynolds *et al.*, 2003). In a survey of family growth in the US, the impact of income and insurance status on access to different levels of fertility service provision were assessed. The investigators noted that seeking advice (*i.e.* consultation) for infertility was the only fertility service that was not influenced by either insurance status or income level (Staniec & Webb, 2007). The investigators also noted that insurance coverage increased the likelihood that women would pursue treatment with medications only or with surgery compared with 'no treatment' observed with uninsured women. A trend showing that low-income women were more likely to pursue the 'no treatment' option was also observed. Additionally, for low-income women there was only an 11% chance that they would pursue ART. In contrast, high-income women were almost two-times as likely to pursue the ART treatment option (Staniec & Webb, 2007). An analysis in Germany has shown that introducing IVF/ICSI co-payments resulted in a shift in utilisation towards older-aged females which may reflect increased financial abilities and poorer prognosis for conception without immediate treatment (DIR, 2005).

The relationship between cost and patient dropout is better understood because this involves exploration of choices made by couples already being on treatment. Because treatment costs are high it is tempting to suggest that this is one of the main reasons that people do not pursue treatment or withdraw from treatment once they have initiated. While cost is often one of the most prominent variables explaining discontinuation rates, psychological factors are often seen to be more influential in decision making on whether or not to start (Goldfarb *et al.*, 1997; Malcolm & Cumming, 2004; Rajkhowa *et al.*, 2006). The limited influence of financial constraints on dropout rates suggests that cost more likely influences on whether couples decide to access treatment at all. This is supported by price-elasticity studies in other healthcare areas where costs more often influence decisions to pursue treatment rather than the volume of consumption once the initial decision to be treated has been taken (Ringel *et al.*, 2002). This might suggest that people who can afford access to ART to begin with are more likely to discontinue for reasons other than cost.

### The externality of fertility treatment outcomes

How much is society willing to pay for an ART-conceived child? Should fertility treatments be publicly subsidised? From which perspective do we evaluate ART-conceived children? These are only

some of the questions that economists and policy analysts are likely to consider regarding fertility treatments. As the proportion of children born from ART increases ever year, there is a pressing need to understand the societal impact of these children who would not have been born if reproductive technologies were not available. Furthermore, when the annual numbers of ART-conceived children are positioned within the population ageing debate, the poignancy of this subject takes on heightened relevance (Hoorens et al., 2007; Sunde, 2007).

Assisted reproductive techniques have been available for more than 30 years, and to date few studies have considered the societal implications of the growing numbers of children that are adding to our demographic footprint every year. While debate has focused on ethical issues regarding the delivery of fertility care, the aggregate number of children born each year has steadily increased reaching up to 6% of annual births in some countries (Andersen & Erb 2006). Because of this, ART now attracts the attention of demographers and economists bringing with them new approaches for evaluating the impact of reproductive technology.

The conventional approach for valuing fertility outcomes is defined in clinical terms based on live births, adverse events and multiple pregnancies. What is seldom considered in relation to ART outcomes is the externality of aggregated fertility treatment outcomes that goes beyond the benefits conferred on individual couples. The term 'externality' is used to describe how the actions or inactions of others can directly or indirectly influence those unrelated to the initial action. From this perspective, it is possible to consider how the number of children born from ART every year can have a measurable externality that impacts on all of us. Namely that these children grow to become adults and engage in economic activities that influence the supply and demand for goods and eventually pay taxes to support an increasing proportion of retired persons. At a time when issues of sustainability are occupying the minds of many European leaders because of falling birth rates and ageing populations, it needs to be recognised that these children make a small but meaningful contribution to society (Hoorens et al., 2007; European Parliament, 2008).

In recent years considerable attention has been given to falling birth rates and ageing populations. In an economic context these demographic outcomes can appear rather innocuous. However, in the knowledge that demographics often drive economies it is clear that these demographic outcomes do have economic consequences (Longman, 2004). As such concerns over birth rates are valid because of their influence over economies now and in the future, and in particular the proportion of working aged persons

relative to non-working aged persons that can impact on public finances. When demographic parameters are interpreted in an economic context it is clear that the numbers of children alive now and born in the future can influence both the absolute number of tax payers as well as future rates of taxation (Kotlikoff, 1992; Raffelhüschen, 1999; Cardarelli et al., 2000; IGR, 2007). Therefore, birth rates do matter for all of us.

If babies do matter, then what is the role of ART and its significance in the ageing debate. Although the contribution of ART-conceived children to national birth rates are small, even small changes in total fertility rates (TFRs) can influence demand for government services and influence tax revenues over many generations (Cardarelli et al., 2000). The likely consequences of demographic changes that are occurring, and the growing number of ART-conceived children in countries with generous public subsidy suggest that all of us have an interest, financial or otherwise, in whether or not reproductive technology is made available. The same could also be said for restrictive legislation that inhibits the effective delivery of fertility treatments (Ciriminna et al., 2007).

The externality of fertility treatments are exemplified by a 2006 fertility policy decision in Korea. Prior to 2005, there was no public subsidy of fertility treatments in Korea. The lack of funding was reversed in 2006 providing reimbursement for up to two treatment cycles of IVF per couple. The funding decision was not an urge of compassion for infertile couples by the Korean Legislature, rather the decision was taken because of the baby shortage that exists in Korea and concerns over future economic sustainability associated with an ageing population (Auerbach & Chun, 2003; Kim, 2007). Korea is not alone in this respect where it has been argued that Israel's generous fertility funding is aligned not only with its pronatalist traditions but also with achieving demographic goals (Birenbaum-Carmeli, 2004).

Demographers often study the effectiveness of population policies used by governments to influence birth rates in which a TFR of 2.1 is considered necessary for maintaining a stable population (Grant et al., 2004). These policies often include subsidised childcare, baby bonuses and direct financial transfers. The intentions of these policies are varied, often with the aim of reducing the financial burden of raising children, but sometimes the aim is more explicit to increase birth rates. The effectiveness of such policies is inconclusive, and where effects exist they are often shown to have limited impact (Grant et al., 2004). Demographers often conclude that at best, population policies are more likely to influence the timing of children rather than the absolute

number of children per couple. In contrast, fertility treatments can directly influence the absolute numbers of children born to a particular couple. This is because non-fecund couples can be made fecund through medical intervention, thereby contributing to the TFR.

Demographic exploration of ART policies and live birth rates has suggested that the contribution of ART to TFR is comparable to the effects of population policies used by many governments. These conclusions were based on examining TFRs in Denmark and the UK where ART was shown to account for 0.07 and 0.02 of the TFR in each country, respectively (Hoorens et al., 2007). When the contribution of ART was compared with findings from a review of population policies in OECD countries, the contribution of ART to TFR was found to be comparable with population policies used by governments (Gauthier & Hatzius, 1997; Hoorens et al., 2007).

### The economic value of ART infants

Expenditure on healthcare is increasingly discussed as an investment that influences economic growth. In a report to the European Commission, it was suggested that 'policy-makers who are interested in improving economic outcomes (e.g. on the labour market or for the entire economy) would have good reasons to consider investment in health as one of their options by which to meet their economic objectives (Suhrcke et al., 2005)'. Applying such a framework to health improvements highlights that health is a form of human capital that can be used to produce economic benefits – namely in the form of labour force participation and normally valued using labour wage rates (Rice & Cooper, 1967; Grossman, 1972). The extent to which this relationship applies to fertility treatments is determined by the known drivers of economic growth.

To better understand the contribution of fertility treatments and live births on economic growth it is useful to consider the model developed by Robert Solow which defines the determinants of economic growth. The work conducted by Solow for which he was later awarded the Nobel Prize in economics in 1987 describes the three main determinants of economic growth as: Innovation (A); Capital (K); and Labour supply (L) (Solow, 1956). According to the relationship defined in the Solow model an increase in either A, K or L can lead to economic growth. Because of this it is possible to position the future supply of labour (L) attributed to ART-conceived children within this relationship, and the economic contribution attributed to the 2–4% of annual births from ART observed in several

countries. Equally, the relationship helps us to understand why ageing populations are of concern because of reductions in the supply of labour that are imminent in many countries.

Because ART-conceived children represent a pool of future labour supply, and these children can be evaluated using human capital ideas, it is possible to evaluate the benefits of ART in monetary terms (Rice & Cooper, 1967). In economic terms, investing healthcare resources to create a life using IVF or investing to save a life requires the same methodological framework for valuing human capital. Whether you save a life or create a life by investing in health, the end result is the same in that there is one additional person alive who would not have been alive if decisive medical care to save or to create life had not been taken. Accordingly, ART-conceived children can be valued using human capital methods using labour market wage rates to assess the value of a life (Rice & Cooper, 1967).

To give some idea of the benefits to governments from investing in IVF programs, we previously explored the return on investment from fertility programs using a human capital approach and the resulting tax revenue for government that arise from investing in ART. The approach applied a narrow government perspective to calculate lifetime net tax revenue derived from an IVF-conceived child (Svensson et al., 2008; Connolly et al., 2009b). After deducting lifetime direct government financial transfers such as education, health, allowances and pensions, the average lifetime net tax contributions from the government perspective were estimated for an IVF child. Results from the UK indicate that a singleton IVF child born in 2005, assuming they are average in every respect, will pay £110,000 discounted and £603,000 undiscounted lifetime net taxes (Connolly et al., 2009b). Based on the investment costs of approximately £13,000 per IVF-conceived child, this represents more than an eight-fold return on investment for government in discounted future tax revenue. This framework is also useful for highlighting the long timeframes that are required to evaluate economic benefits from investing in health programs.

In practice the evidence base suggesting that population growth stimulates economic prosperity is unclear (Bloom et al., 2003). Rather, what is increasingly recognised is that the proportion of working-aged population relative to economically inactive cohorts is more likely to influence economic growth. Therefore, simply increasing birth rates now whether through natural or assisted conception does not immediately translate into economic benefits. Rather, the benefits are observed as these children enter the workforce – a point supported by the tax-based evaluation described previously.



What is notable with respect to population policies and the resulting economic benefits are the long timeframes required for policies to take effect. Therefore, policies implemented today require considerable foresight about future age-dependency ratios and societal needs. This might suggest that if ART provision were positioned as pronatalist or population policy, it calls into question whether health services that often focus on short time horizons are in a position to appreciate fully the benefits attributed to ART-conceived children. Had fertility treatments been funded by other government departments, for example, the tax collection agency or family services, perhaps funding for fertility treatments would be seen as a much higher priority than often exists today.

## Conclusions

The two economic aspects discussed in this article – access to fertility treatment and the economic value of ART-conceived children – although seemingly distinct, do share some commonality. They are related by the manner in which health services perceive expenditure allocated to fertility treatments. In health services where infertility is a low priority, it attracts limited funding and fertility treatments are mostly viewed as a cost. Because of the limited funding, many infertile couples are unable to access treatment which no doubt influences the number of children that could be born every year in the absence of financial barriers. However, the economic approach applied to value fertility treatment illustrates that such treatment is actually an ‘investment’ that yields future economic benefits. While the benefits are not immediate, what is viewed as a cost today is actually an investment, when considered over longer periods of time.

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